New data on *Pauluccinella minima* (Paulucci, 1881) (Prosobranchia: Hydrobiidae): distribution in Italy

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KEY WORDS: Gastropoda, Prosobranchia, Hydrobiidae, *Pauluccinella minima*, zoogeography, Italy

ABSTRACT A new areal distribution of *Pauluccinella minima* (Paulucci, 1881), a crenophilous Hydrobiidae believed endemic of some springs in the Matese Mountain, is introduced and discussed in this paper.
The occurrence of *P. minima* has been detected in twelve new stations, almost regularly spaced along the Apennine Chain, allowing to better define the relevant chorology and the communities characteristics.
All the stations are located into springs directly connected to the present surface hydrographic network. This suggests the mountain sectors have never been colonised, not even while they could have been reached through fluvial interstitial lattice migration pathways, i.e. at the end of the last glacial event: the *P. minima* populations remained therefore confined within the valley sectors.

RIASSUNTO In questo lavoro è presentato e discusso un nuovo areale distributivo di *Pauluccinella minima* (Paulucci, 1881), un Hydrobiidae crenofilo ritenuto finora endemico di alcune sorgenti della Montagna del Matese.
P. minima è stata rinvenuta in dodici nuove stazioni, regolarmente distribuite lungo la Catena Appenninica, consentendo la caratterizzazione delle varie comunità e la definizione di un più esauriente quadro corologico.
Tutte le stazioni risultano localizzate in sorgenti direttamente connesse all'attuale rete idrografica di superficie.
Questo può significare che i settori montani non sono mai stati colonizzati da *P. minima*, neanche quando questi potevano essere raggiunti attraverso vie di migrazione localizzate nei reticoli interstiziali fluviali alla fine dell'ultimo evento glaciale. Questo mancato adattamento ha fatto si che *P. minima* rimanesse definitivamente confinata nei settori vallivi.

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DISCUSSION

Pauluccinella minima is a crenophilous hydrobiid described for the first time at the end of the XIX century in some springs situated along the south-west side of the Matese Mountain (Paulucci, 1881).

The *P. minima* distribution (=*Pseudoammicola reatina* Stella, 1961 - junior synonym in Bodon et Al., 1995) was then discontinuously enlarged towards the north, having been found in Peschiera Spring (North-eastern Latium).

During malacological researches carried out during the 80's, a further finding at the Biferno Spring on the north-east slope of the Matese Mountain, extended the distribution area eastwards (Giusti & Pezzoli 1980, 1981).

Other findings in Clitunno Spring (Cossignani & Cossignani, 1995) and in Lake Piediluco (Pettinelli & Castagnolo, 1996), allowed to better understand the taxon chorology and the ecological habitat of the lake populations.

The studies of the last six years, still in progress, in the centre and in the south of Italy, gave the possibility of detecting several *P. minima* populations in areas very far from the locus typicus. The new findings (twelve stations) are well distributed along the Apenninic Chain from the Matese Massif to the Gualdo Tadino Plain, outlining the northern occurrence boundary (see appendix I and fig. 1).

P. minima prefers cold water, with high levels of dissolved O_2 and also rich in $CaCO_3$, but it has also adapted itself to lotic (M. Argento Channel, spring stream near Villaggio Matteotti, S. Rocco Channel) and lentic waters (Lake Piediluco) with medium eutrophyzation.

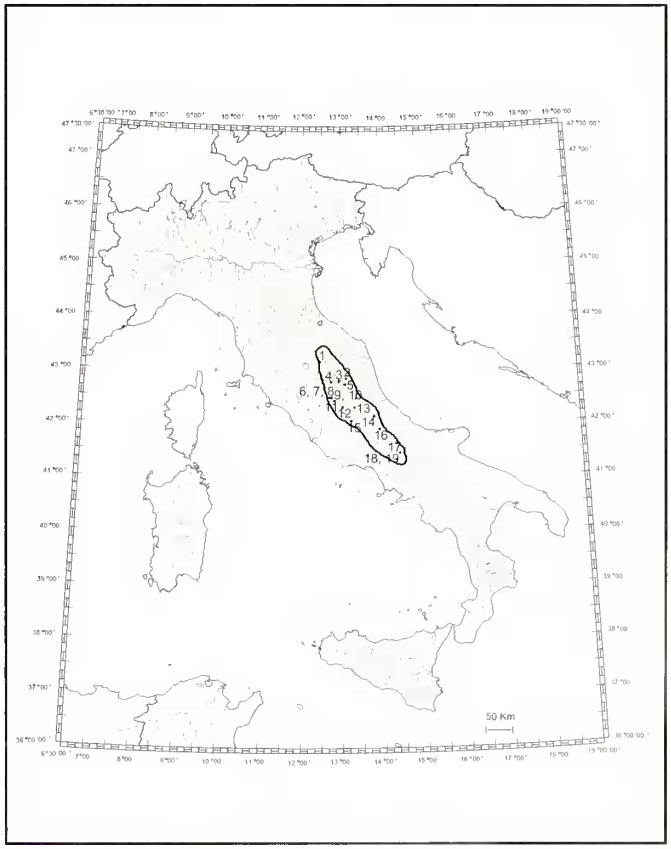

Fig. 1. *Pauluccinella minima* (Paulucci, 1881) distribution in Italy. See appendix I for the stations list.

Generally lentic waters populations, particularly those found in Lake Piediluco, are significantly diversified in several phenotypes, probably related to the variability of the edaphic conditions relevant to each particular environment (pl. 1).

On the other hand the majority of the known populations, colonise limnocrenic springs (Clitunno Spring, S. Susanna Spring, Peschiera Spring, Pescara Spring, Gizio stream spring), adapting themselves to biotopes with unstable chemical and physical parameters, or are confined into sources with stronger environmental conditions (rheocrenic, karstic, etc.).

The Triponzo sulphureous spring population, which is different from all the others, is the only one which is able to colonise the thermal waters mixed with of the Nera River ones, the molluscs live in fact in a clearly defined riverbed substratum. The animal benefit there of the spring water high $CaCO_3$ concentration remaining in the meantime protected from the high temperature (29° C at the source) and low PH (related to the H_2S presence) typical of thermal water environments.

At present, the chorological panorama of the species and its complex migration mechanisms could be related to the post Würmian Glaciation, when quick climate variations were responsible for the hydrographic network modification.

P. minima communities are mostly distributed in limnocrenic springs (originated after most of the villafranchian lakes were dried upon the rapid fall of the local piezometric level) or in major sources bordering the Apenninic Chain. In any case they can be found in waters connected with the surface fluvial network. Up to now in fact, no *P. minima* populations are known to have reached remote spring biotopes were, conversely, the occurrence of the other kindred creno-stygobiont genera (*Bythinella, Belgrandia, Islamia,* etc.) is frequent.

This might indicate that *P. minima* populations haven't been able adapting themselves to the interstitial fluvial environment so that they could not migrate towards the mountain sectors of the streams, as almost all the other creno-stygobiont genera did.

At the end of the Würmian Glaciation, when the waters were getting warmer, these last taxa, adapted to live into the interstitial fluvial waters, could migrate towards the rheocrenic stream zones, characterised by more stable conditions with respect to the flowing waters.

It was probably for this reason that *P. minima,* unable to survive into interstitial waters, was forced to follow different migration directions towards spring biotopes with low water energy, along lower fluvial portions and in lakes generally placed in flat areas.

The populations originated after the migration process, for the progressive heating and the subsequent change of the fluvial network, began to break any connection between them, outlining the current chorological configuration where the communities links are definitively lost.

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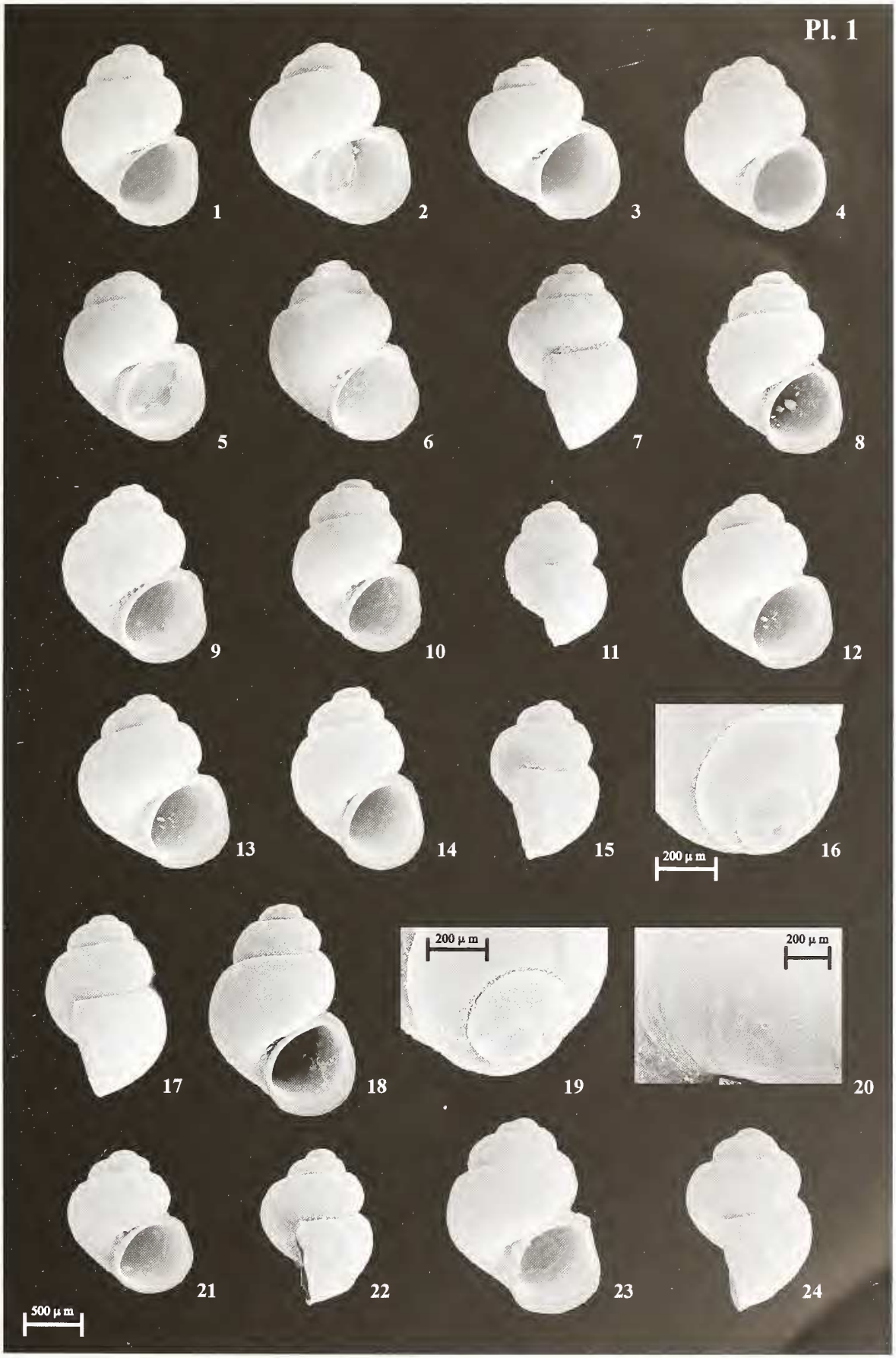
APPENDIX I

Old and new stations of *Pauluccinella minima* (Paulucci, 1881) in Italy

1. "Boschetto" spring into the artificial channel of a mill between Boschetto and Gaifana (Perugia)
Lat. 43° 10' 38" N, Long. 12° 47' 28" E, 513 m m.s.l.; R. Pettinelli leg., sample date: 06.10.1996.

PLATE 1. Shells of *Pauluccinella minima* (Paulucci, 1881). Fig. 1 Boschetto Spring. Fig. 2 Acqua della Salute Spring. Fig. 3 Triponzo sulphureous spring. Fig. 4 Clitunno Spring. Fig. 5 Salicone Spring. Fig. 6-7 M. Argento Channel. Fig. 8 Spring stream near Villaggio Matteotti. Fig. 9 S. Rocco Channel. Fig. 10-11 Lake Piediluco. Fig. 12-13 S. Susanna Spring. Fig. 14-15 "Fonte delle 99 cannelle" spring. Fig. 16 "Fonte delle 99 cannelle" spring, detail of the protoconch microsculpture. Fig. 17-18 Pescara River spring. Fig. 19 Pescara River spring, detail of the protoconch microsculpture. Fig. 20 Pescara River spring, detail of the last whorl microsculpture of the teleoconch. Fig. 21-22 Imele Stream spring. Fig. 23-24 Gizio Stream spring. Use the scale bar at the bottom of the plate when it doesn't compare in the figures.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2. "Acqua della Salute" karstic spring, Castelsantangelo sul Nera (Macerata)
Lat. 42° 53' 30" N, Long. 13° 09' 35" E, 775 m m.s.l.; R. Pettinelli leg., sample date: 20.06.1993.

3. Sulphureous karstic spring along the right bank of the River Nera (4th from NE), near the ancient roman thermal baths of Triponzo (Perugia)
Lat. 42° 50' 22" N, Long. 12° 56' 57" E, 398 m m.s.l.; R. Pettinelli leg., sample date: 17.05.1992.

4. Clitunno River limnocrenic spring, Campello sul Clitunno (Perugia)
Lat. 42° 49' 56" N, Long. 12° 46' 06" E, 228 m m.s.l.; R. Pettinelli leg., sample date: 23.01.1992.
References: (Cossignani & Cossignani, 1995).

5. "Salicone" spring, Norcia (Perugia)
Lat. 42° 47' 40" N, Long. 13° 05' 24" E, 580 m m.s.l.; R. Pettinelli leg., sample date: 30.07.1992.

6. Artificial channel of the River Nera coming out from hydroelectric power station "Monte Argento" (Terni)
Lat. 42° 33' 04" N, Long. 12° 40' 13" E, 170 m m.s.l.; R. Pettinelli leg., sample date: 24.04.1996.

7. Spring stream in locality "Villaggio Matteotti" (Terni)
Lat. 42° 33' 00" N, Long. 12° 39' 30" E, 145 m m.s.l.; R. Pettinelli leg., sample date: 12.11.1993.

8. Artificial channel "S. Rocco" of the River Nera, S. Rocco (Terni)
Lat. 42° 32' 21" N, Long. 12° 38' 31" E, 175 m m.s.l.; R. Pettinelli leg., sample date: 15.06.1997.

9. Lake Piediluco near "Stoney" dam on the River Velino artificial channel (Terni) (Stat. 2 in Pettinelli & Castagnolo, 1996)
Lat. 42° 32' 00" N, Long. 12° 44' 09" E, 372 m m.s.l.; R. Pettinelli leg., sample date: 15.12.1992.
References: (Pettinelli & Castagnolo, 1996).

10. Lake Piediluco in "S. Egidio" locality on the northern side of Caperno Mountain (Terni) (Stat. 1 in Pettinelli & Castagnolo, 1996)
Lat. 42° 31' 49" N, Long. 12° 45' 17" E, 372 m m.s.l.; R. Pettinelli leg., sample date: 15.12.1992.
References: (Pettinelli & Castagnolo, 1996).

11. "S. Susanna" limnocrenic spring (Rieti)
Lat. 42° 30' 05" N, Long. 12° 51' 11" E, 390 m m.s.l.; R. Pettinelli leg., sample date: 24.10.1992.

12. "Peschiera" limnocrenic spring (Rieti)
Lat. 42° 22' 05" N, Long. 13° 00' 41" E, 411 m m.s.l.; R. Pettinelli leg., sample date: 17.01.1993.
References: (Stella, 1961)

13. "Fonte delle 99 cannelle" spring (L'Aquila)
Lat. 42° 20' 56" N, Long. 13° 23' 24" E, 670 m m.s.l.; R. Pettinelli leg., sample date: 23.04.1995.

14. Pescara River karstic spring, Popoli (L'Aquila)
Lat. 42° 09' 48" N, Long. 13° 49' 17" E, 245 m m.s.l.; R. Pettinelli leg., sample date: 20.11.1995.

15. Imele Stream karstic spring, Tagliacozzo (L'Aquila)
Lat. 42° 03' 54" N, Long. 13° 14' 43" E, 820 m m.s.l.; R. Pettinelli leg., sample date: 07.09.1995.

16. Gizio Stream limnocrenic spring, Pettorano sul Gizio (L'Aquila)
Lat. 41° 57' 32" N, Long. 14° 21' 13" E, 335 m m.s.l.; R. Pettinelli leg., sample date: 17.11.1995.

17. "Biferno River spring, presso Boiano, Monti del Matese (Campobasso, Molise)"
References: (Giusti & Pezzoli 1980, 1981).

18. "S. Agata nel Matese" (Caserta)
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19. "Torano in Terra di Lavoro" (Caserta)
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